

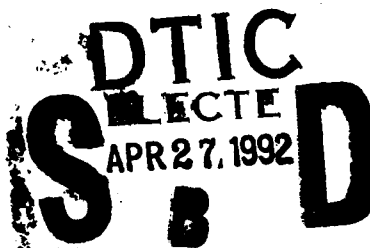
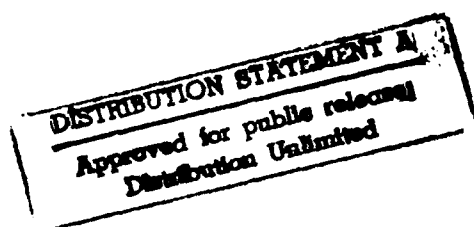
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FINAL REPORT
AUGUST 1990

REPORT NO. EVT 25-90

MIL-STD-1660 TESTS FOR
PA117 CONTAINERS ON METAL
PALLETS WITH ADAPTERS



Prepared for:

U.S. Army Armament Research,
Development and Engineering Center
ATTN: SMCAR-AEP
Picatinny Arsenal, NJ 07806-5000

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MIL-STD-1660 TESTS FOR
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PART 1

INTRODUCTION

A. BACKGROUND.

The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV) was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), SMCAR-AEP, to test PA117 containers on metal pallets with adapters containing top lift capability to determine if this design meets MIL-STD-1660, Design Criteria for Ammunition Unit Loads.

B. AUTHORITY.

This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. OBJECTIVE.

The objective of this series of tests was to assess the ability of the metal pallet and adapters unitized with PA117 containers to meet MIL-STD-1660, Design Criteria for Ammunition Unit Loads.

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PART 2

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PART 3

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is considered to be acceptable. The five tests that were conducted on the test pallet are synopsized below.

1. STACKING TESTS. The unit load shall be loaded to simulate a stack of identical unit loads stacked 16 feet high for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression of weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner: The unit load weight is multiplied by 192 minus the unit height in inches, then divided by the unit height in inches, then multiplied by a safety factor of two. The resulting number is the equivalent compressive force of a 16-foot-high load.

2. REPETITIVE SHOCK TEST. The repetitive shock test shall be conducted in accordance with Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen shall be placed on, but not fastened to the platform. With the specimen in one position, vibrate the platform at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of about 3 cycles-per-second. Steadily increase the frequency until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle, or when a platform acceleration achieves $1 \pm 0.1G$. Midway into the testing period, the specimen shall be rotated 90 degrees, and the test continued for the duration. Unless failure occurs, the total time of vibration shall be two hours when the specimen is tested in one position. When the specimen is tested in more than one position, the total time shall be three hours.

3. **EDGEWISE ROTATIONAL DROP TEST.** This test shall be conducted by using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Rotational Drop Test is as follows: The specimen shall be placed on its skids with one end of the pallet supported on a beam 4 1/2-inches high. The height of the beam shall be increased, if necessary, to ensure that there will be no support for the skids between the ends of the pallet when dropping takes place, but should not be high enough to cause the pallet to slide on the supports when the dropped end is raised for the drops. The unsupported end of the pallet shall then be raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection shall conform to the following tabulation:

GROSS WEIGHT NOT EXCEEDING	DIMENSIONS ON ANY EDGE NOT EXCEEDING	HEIGHT OF DROP LEVEL A PROTECTION
Pounds	Inches	Inches
600	72	36
3,000	no limit	24
no limit	no limit	12

4. **SLING COMPATIBILITY TEST.** Unit loads utilizing special design for nonstandard pallets shall be lifted, slung, lowered, and otherwise handled, as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings shall be easily attached and removed. Danger of slippage or disengagement when load is suspended shall be cause for rejection of the unit load.

5. **IMPACT TEST.** This test shall be conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the Incline-Impact Test is as

follows: The specimen shall be placed on the carriage with the surface or edge which is to be impacted projecting at least two inches beyond the front end of the carriage. The carriage shall be brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber may be attached to the bumper in the desired position before the test. No part of the timber shall be struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts may be at the option of the testing activity and will depend upon the objective of the tests. When the test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen shall be subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact shall be 7 feet-per-second.

PART 4

TEST EQUIPMENT

1. TEST PALLET.

- | | |
|--------------------|--------------------------|
| a. Drawing Number: | AC200000 |
| b. Unitization: | 30 105mm Rounds |
| c. Height: | 41 inches (104.14cm) |
| d. Width: | 42-1/2 inches (107.95cm) |
| e. Length: | 44-1/2 inches (113.03cm) |
| f. Weight: | 2,375 pounds (1,077kg) |

2. COMPRESSION TESTER.

- | | |
|-----------------------|------------------------|
| a. Manufacturer: | Ormond Manufacturing |
| b. Platform: | 60 inches by 60 inches |
| c. Compression Limit: | 50,000 pounds |
| d. Tension Limit: | 50,000 pounds |

3. TRANSPORTATION SIMULATOR.

- | | |
|------------------|--------------------|
| a. Manufacturer: | Gaynes Laboratory |
| b. Capacity: | 6,000-pound pallet |
| c. Displacement: | 1/2-inch Amplitude |
| d. Speed: | 50 to 400 rpm |
| e. Platform: | 5 foot by 8 foot |

4. INCLINED RAMP.

- | | |
|------------------|--------------------|
| a. Manufacturer: | Conbur Incline |
| b. Type: | Impact Tester |
| c. Grade: | 10 percent Incline |
| d. Length: | 12-foot Incline |

PART 5

TEST RESULTS

1. STACKING TEST. Test pallets were compressed to a maximum of 18,500 pounds to obtain the target weight of 17,881 pounds. During this test, 1 1/4-inch unitization straps were noted to be loose during compression, but returned to desired tension after testing. All pallets passed this test without damage or permanent deformation occurring.
2. REPETITIVE SHOCK TEST. All pallets were vibrated between 175 and 210 revolutions per minute (rpm) during this phase of testing with variations in rpm required to obtain the 1/16-inch clearance between the vibration table and the pallet skids. The first three tests conducted used only two 3/4-inch bundling straps to unitize the PA117 containers (reference top three layers only). This procedure resulted in severe racking of the containers when positioned perpendicular to the applied motion of the vibration table. During the final test, four 3/4-inch bundling straps were used (reference top three layers, and layers 2, 3, and 4 from the top). This procedure is similar to the current pallet unitization procedures used for PA116 containers. This method greatly reduced racking on the PA117 containers.
3. EDGEWISE ROTATIONAL DROP TEST. Racking was noted during this test when two 3/4-inch bundling straps were used and resulted when impacts were parallel to the skids. All four pallets passed this test with some permanent deformation to the 40- by 44-inch metal pallet.
4. IMPACT TEST. The incline-plane was set to allow the pallet to travel eight feet prior to impacting a stationary wall. During this test, 1/2-inch gaps were noted between the PA117 containers and the top pallet adapter. Upon completion of this test, permanent deformation to the top adapter was noted at points of contact with the square bell and stacking rings. This

deformation contributed to the gap noted above. All pallets passed this test without additional problems being encountered.

5. SLING TEST. No problems were encountered during the 2- and 3-legged sling lifts; however, during the one-legged sling lift, the following problems were encountered: On the first pallet, one PA117 stacking lug popped out but returned to its nested position after testing. On the second pallet, permanent deformation was noted to the lifting ring, and, due to workmanship, errors in not welding critical points on the lifting ring support. On the third pallet, the top adapter assembly shifted 1 5/8-inches up and over the square bells on the PA117 containers with the pallet marginally stackable after testing. With the use of four bundling straps and proper welding procedures during the fourth test, all problems noted above were resolved.

PART 6

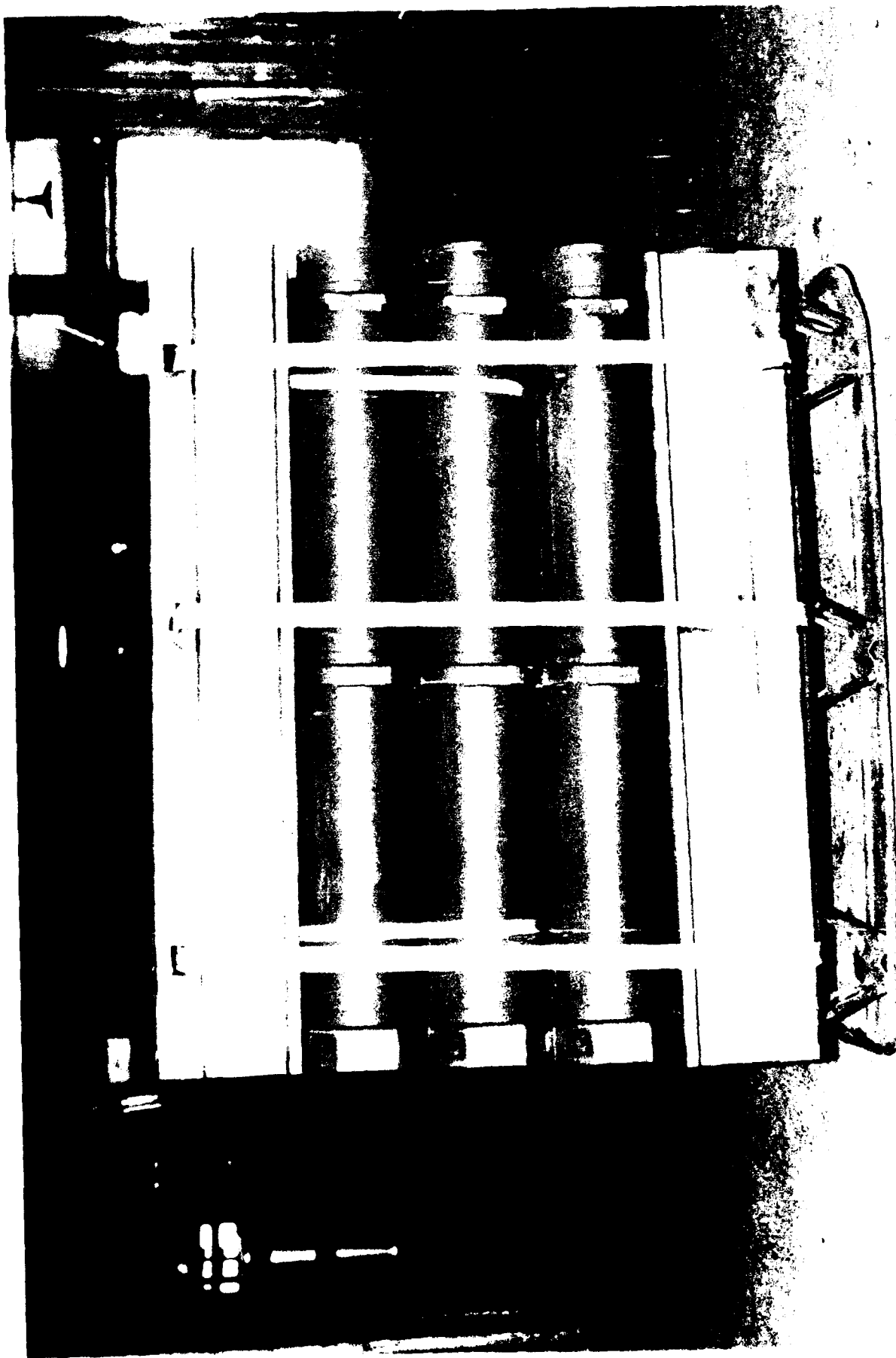
CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS. Attempts were made to reduce the number of 3/4-inch bundling straps from four to two with this procedure not being successful. With two bundling straps, the PA117 containers had racking and slinging problems. When four 3/4-inch bundling straps were used, no problems were encountered. As tested, the PA117 container and pallet with adapters passed the MIL-STD-1660, Design Criteria for Ammunition Unit Loads.

2. RECOMMENDATIONS. The same unitization procedures that are currently used on the PA116 containers must also be used on the PA117 containers. The technical data package (TDP) should be changed to show the proper location of lateral lip grip slots on the lower adapter assembly. If not changed it will result in the lip grips being damaged. As tested, both the top and bottom pallet adapters appeared to have excessive gaps between the containers and fork tine protectors. Dimensional tolerances should be checked prior to final issuance of the TDP.

PART 7

PHOTOGRAPHS



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. AO317-SPN-90-354-5329. Typical strapping procedures used during the first three tests (reference two bundling straps and three unitization straps).



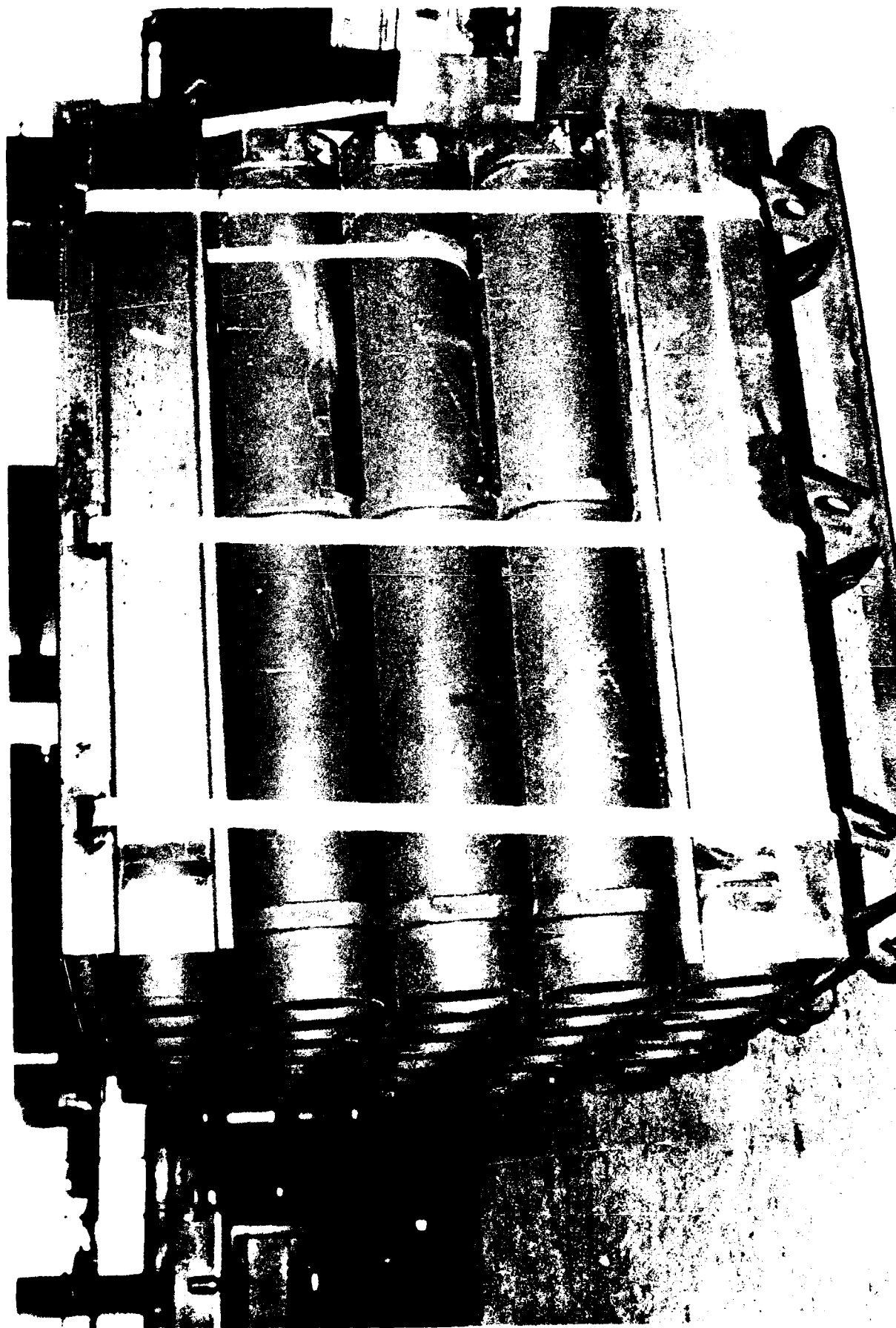
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SPN-90-354-5310. Shows typical clearance between top layer of PA14 containers and top pallet adapter.



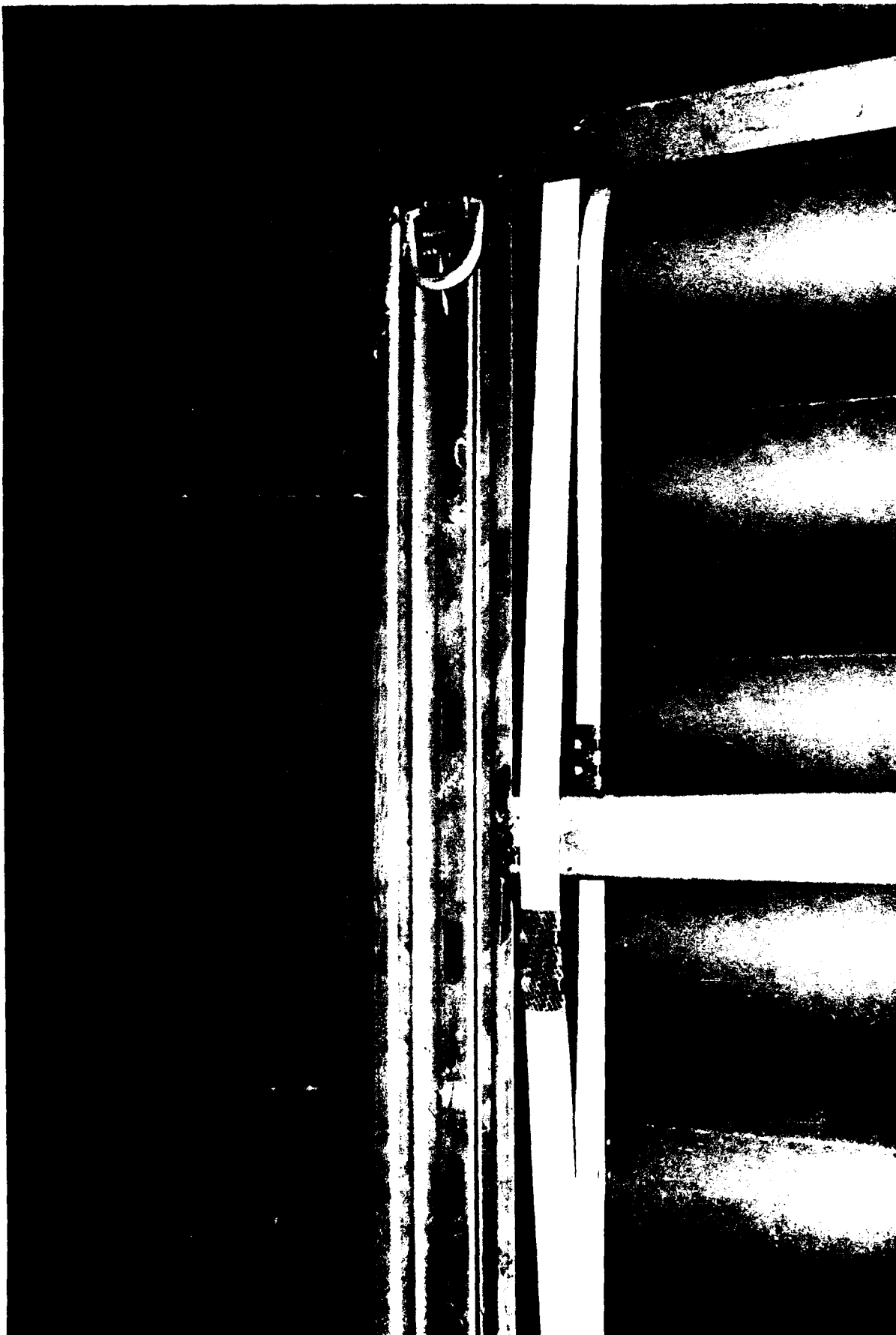
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Photo No. AO317-SPN-90-354-5317. Shows slight bending of top pallet adapter after testing due to lateral gap between container and adapter.

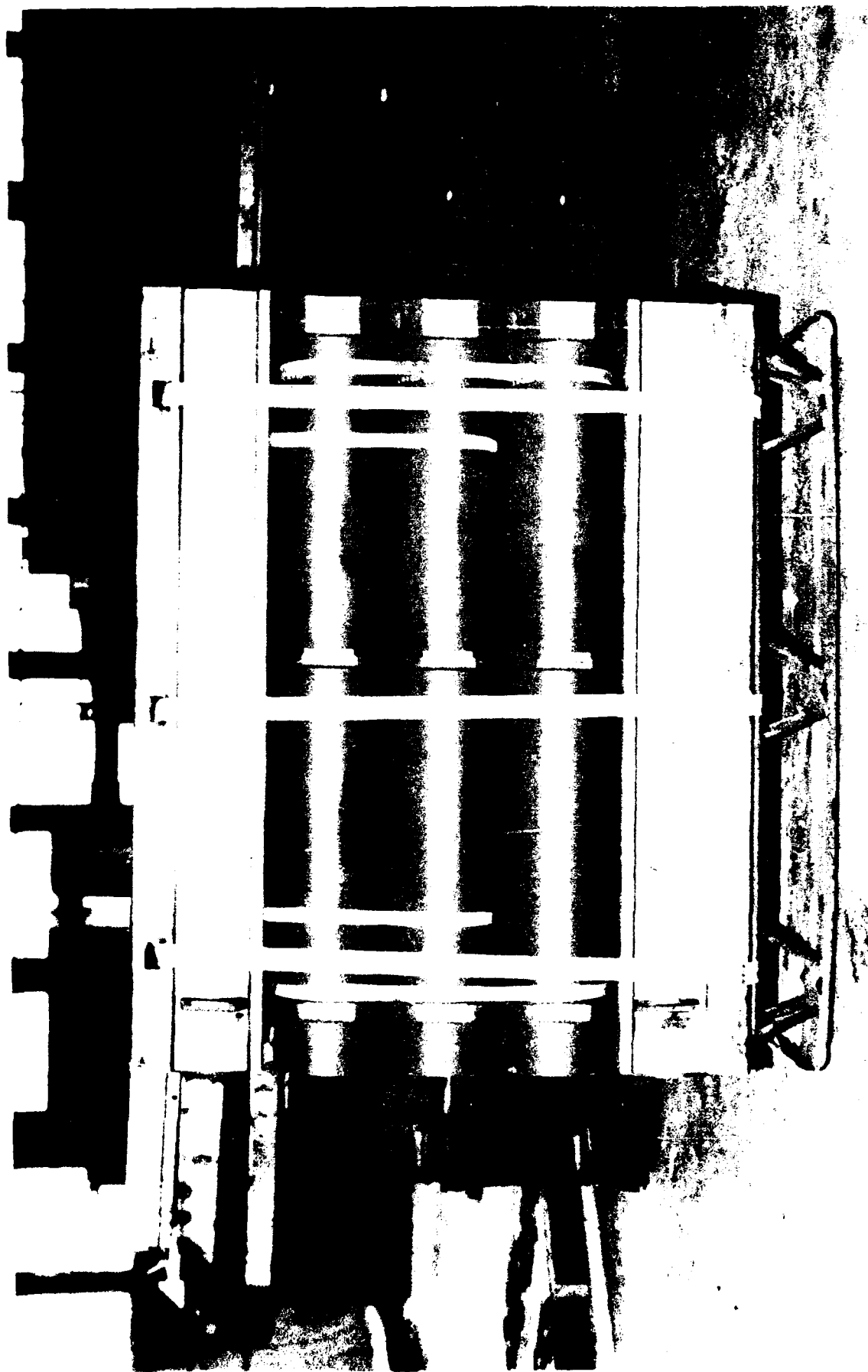


U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SPN-90-354-5330. Shows top pallet adapter shifted 1 5/8 inches after slinging test on third pallet tested.

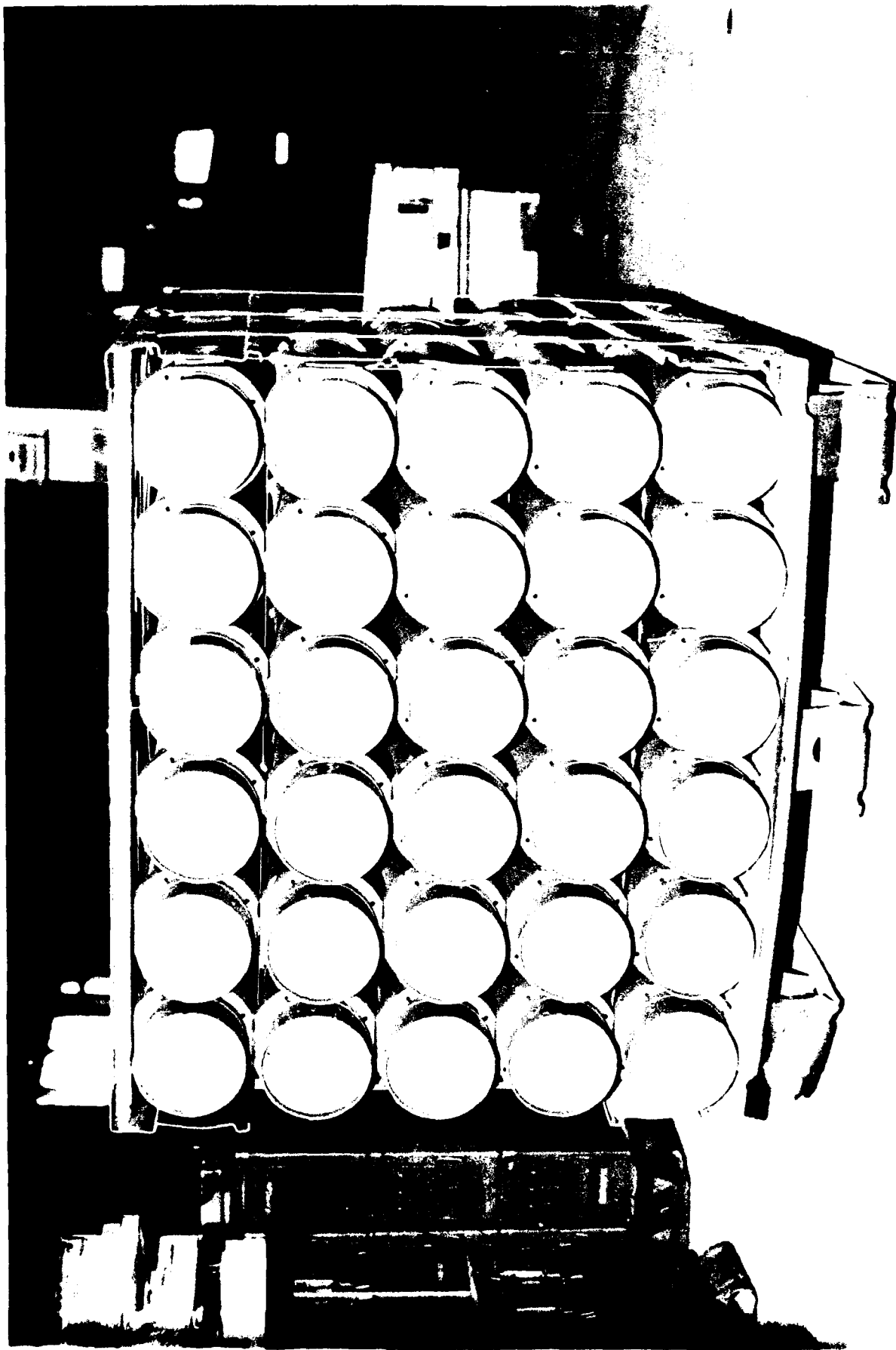


	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. AO317-SPN-90-353-5319. Same pallet as photo No. 3, top view.	



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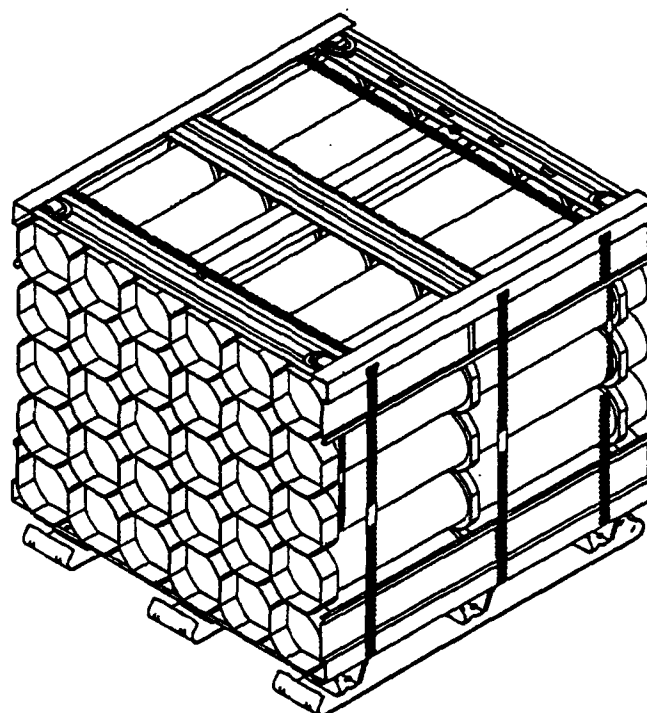
Photo No. AO317-SPN-90-354-5320. Shows strapping procedures used on fourth pallet tested (reference four bundling straps, similar to current procedure on PA116 containers).



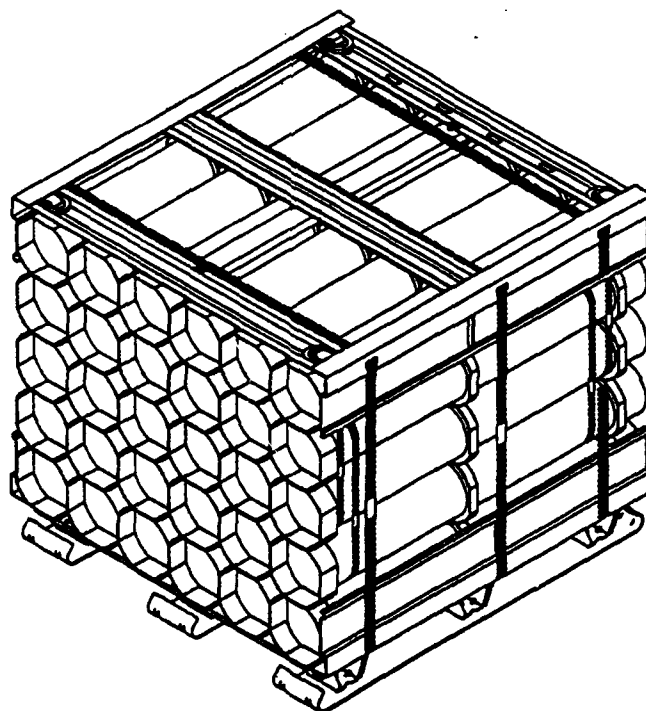
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
	Photo No. AO317-SPN-90-354-5322. Typical damage to pallet skids after testing.

PART 8

DRAWINGS



PA117 CONTAINERS WITH TWO BUNDLING STRAPS



PA117 CONTAINERS WITH FOUR BUNDLING STRAPS